NOAA Fisheries notes and references relating OC coho salmon, CZARA, and Agriculture
RW 2/25/15

Contents of these notes:

NMFS Staff Notes:

Ag plays a key role in the recovery of coho species. The overlap between the most desirable agricultural land and the most desirable coho habitat (highest intrinsic potential) is very high. Low gradient, wide valley bottom, and plenty of water could describe great potential agricultural land or coho habitat.

That was the short answer …the SONCC Recovery Plan's list of threats includes the role agriculture plays – that tells part of the story. In terms of the sources of stress on coho, just about every major stressor can be traced in some way back to an ag related action.

- low habitat complexity in low gradient streams (winter rearing habitat) - development of pasture/crop lands involved ditching and straightening of streams and rivers
- high water temperatures (summer rearing habitat) - causes above with the addition of water withdraw, riparian loss, reduced connection to floodplains are a few of the causes
- reduced summer flow (summer rearing habitat) - water withdraw, loss of connectivity to wetlands and groundwater recharge
- lost intertidal habitat (winter rearing habitat, estuary migration, alternative life history strategies) - diking, tidegates, transportation infrastructure

(Thanks, Ken Phippen, for your input in the notes above)

In terms of recovery actions, agriculture poses another type of challenge compared to forest practices. For example, there are a relative large number of agricultural landowners, the parcels are relatively small, the financial status of the ag businesses is often marginal, available incentives inadequate, and the local culture is sometimes hostile to government efforts to restore fish. These factors make it difficult to find landowners in agricultural business in or near salmon habitat who are willing and able to for habitat protection and restoration activities.

Rob Walton

Excerpts from listing decision: 76FR35755

- Agricultural activities have removed stream-side vegetation.
- Stormwater and agricultural runoff reaching streams is often contaminated by hydrocarbons, fertilizers, pesticides, and other contaminants. In the Umpqua River basin, diversion of water for agriculture reduces base stream flow and may result in higher summer stream temperatures.
- Conversion of forest and agricultural land to urban and suburban development is likely to result in an increase in these effects in the future (Burnett *et al.,* 2007).
- *Agriculture*
  Across all populations, agricultural lands occupy approximately 0–20 percent of lands adjacent to OC coho salmon habitat (Burnett *et al.,* 2007). Much of this habitat is considered to have high intrinsic potential (low gradient stream reaches with
  historically high habitat complexity) but has been degraded by past management activities (Burnett *et al.,* 2007). In our proposed rule, we presented an analysis of the degree of protection afforded to
  OC coho salmon habitat by: (1) Agricultural water quality programs, (2) state water quality management plans for confined animal feeding operation, (3) state pesticide programs, (4) the Federal pesticide labeling program, and (5) irrigation and water availability regulations. We concluded that these state and Federal programs are partially effective at protecting OC coho salmon habitat. Many of the agricultural actions that have the greatest potential to degrade coho habitat, such as management of animal waste, application of toxic pesticides, and discharge of fill material, have some protective measures in place that limit their adverse effects on aquatic habitat. However, deficiencies in these programs limit their effectiveness at protecting OC coho salmon habitat. In particular, the riparian rules of the water quality management program are vague and enforcement of this program is sporadic. The lack of clear criteria for riparian condition will continue to make the requirements of this program difficult to enforce. Levees and dikes can be maintained and left devoid of riparian vegetation regardless of their proximity to a stream. The lack of streamside buffers in the state's pesticide program likely results in water quality impacts from the application of pesticides. Although new requirements from ESA section 7 consultations on Federal pesticide registration may afford more protection to OC coho salmon, these requirements will only apply if the OC coho salmon ESU remains listed. Although a water leasing program is available, there is much uncertainty about how this program will result in increased instream flow. The available information leads us to conclude that it is likely that the quality of OC coho salmon habitat on private agricultural lands may improve slowly over time or remain in a degraded state. It is unlikely that, under the current programs, OC coho salmon habitat will recover to the point that it can produce viable populations during both good and poor marine conditions.

- (7) there are still numerous primary threats to OC coho persistence, including legacy effects from past forest management, poor marine conditions, agricultural activities and urban development in high intrinsic potential habitat, global climate change, etc.; and (8) this ESU faces a long and growing list of secondary threats including invasions of exotic organisms, poor water quality, and land-use conversion. Therefore, we retain the threatened listing for the OC coho salmon ESU.

Excerpts from the Southern Oregon, Northern California (SONCC) recovery plan – Elk Population, related to agriculture. These are a representative of other SONCC populations and OC coho salmon as well:

- Key Limiting Threats are 'Agricultural Practices' and 'Channelization/Diking'
- Highest priority recovery actions include: "Improve regulatory mechanisms regarding agricultural practices
- Over time, settlement and associated agriculture encroached on the lower Elk River floodplain which confined the channel and reduced wetlands.
- Smaller tributaries, such as one near the mouth of Elk River and upstream of Highway 101, are now disconnected or dammed for agricultural water supply.
- Based on the input of panel members, concerns for the Elk River population are as follows:
  Key concerns were primarily loss of over-winter tributary and freshwater estuarine habitat complexity and floodplain connectivity for juveniles, especially in the lowlands which are naturally limited in this system and have been impacted by past and current agricultural practices. Secondary concerns were primarily related to high water temperatures in tributaries for summer parr (excluding the mainstem, where rearing is not expected) and loss of tributary habitat for juveniles and adults due to road crossings (especially in Bagley and Blackberry Creeks)
- Lack of floodplain and channel structure is the greatest constraint to coho salmon production in the Elk River. The lower Elk River channel is disconnected from its floodplain, wetlands, and tributaries (Figure 7-2). This has significantly reduced what was once optimal habitat for coho salmon spawning, egg incubation, and rearing. The ODFW (2008b) Expert Panel found that loss of floodplain connectivity and access to off-channel habitat was a major limiting factor in this population. This stress applies to both freshwater and tidally-influenced freshwater areas. Tributary channels are also altered by agricultural activities, as evidenced in aerial photos (Figure 7-2). One entire fork of Swamp Creek is no longer discernible on aerial photos and has been completely filled in. Large woody debris was historically important and available in the lower Elk River but today there is little large wood (ODFW 2008b).
- **Impaired Estuary/Mainstem Function**
  The main issues for coho salmon in the estuary are insufficient holding habitat for smolts and the barriers described below. Based on aerial photos, most of the land adjacent to the Elk River estuary has been converted to agricultural land, with associated channelization and diking that has disconnected small tributaries.
- The most important barriers in the Elk River are three agricultural dams that block migration of coho salmon and contribute to excessively high water temperature. Two of the dams disrupt Swamp Creek, a tributary to the estuary. The Curry County Soil and Water Conservation District recently improved fish passage at these barriers by installing baffled culverts. They documented coho salmon smolts above the first dam, but fully unimpeded passage has not been confirmed (Swanson, M., pers. comm. 2013).

Table 7-4. Severity of threats affecting each life stage of coho salmon in the Elk River. Threat rank categories, assessment methods, and data used to assess threats are described in Appendix B.

	Threats	Egg	Fry	Juvenile[1]	Smolt	Adult	Overall Threat Rank
1	Agricultural Practices[1]	High	Very High	Very High[1]	Very High	Very High	Very High
3	Channelization/Diking[1]	High	High	High[1]	Medium	Medium	High
2	Dams/Diversions	Low	Medium	High	High	Medium	High
4	Road/Stream Crossing Barriers	-	Low	High	Medium	High	High
5	Roads	Low	Medium	Medium	Medium	Medium	Medium
6	Timber Harvest	Medium	Medium	Medium	Medium	Low	Medium
7	Invasive/Non-Native Alien Species	-	Medium	Medium	Medium	Medium	Medium
8	Climate Change	-	-	Medium	Medium	Medium	Medium
9	High Severity Fire	Low	Low	Low	Low	Low	Low
10	Hatcheries	Low	Low	Low	Low	Low	Low
11	Mining/Gravel Extraction	Low	Low	Low	Low	Low	Low
12	Urban/Residential/Industrial Dev.	Low	Low	Low	Low	Low	Low
13	Fishing and Collecting	-	-	Low	Low	Low	Low

[1]Key limiting threats and limited life stage.

Key Limiting Threats

The two key limiting threats, those which most affect recovery of the population by influencing stresses, are agricultural practices and channelization/diking.

Agricultural Practices

Agricultural practices are the top threat for coho salmon because their impacts are concentrated in the lower basin, where the highest IP habitat exists and where all fish from the upper basin must pass. Agricultural impacts include the loss and filling of wetlands, water diversion, riparian alteration, polluted stormwater runoff, and blocked access to formerly productive tributaries. Areas of bare soil on terraces adjacent to the lower river and estuary, and newly cleared riparian forests, which are apparent in recent aerial photo images, suggest that agricultural activities may be expanding. The ODFW (2008b) expert panel found agricultural activities to be the causal mechanism for a number of factors limiting Elk River coho salmon production. Removal of riparian trees, particularly conifers, associated with agricultural activities decreases shade and promotes increased water temperature. Cattle grazing can degrade bank structure, initiate erosion, and lead to increases in nutrients and pollutants. Non-point source pollution from cranberry cultivation has not been assessed, but the South Coast Watershed Council is working with growers to consider value-added organic options.

Channelization and Diking

The ODFW (2008b) expert panel found that habitat simplification, resulting from straightening, channelizing, revetting, filling, and/or stream channel dredging, was the most limiting stress upon coho salmon in the Elk River. One entire fork of Swamp Creek has been filled. Much of the lower Elk River channel has been diked since the major floods of 1955 and 1964 (USFS 1998a). Channel confinement causes bed load mobility that disrupts redds which results in high stress to eggs. Fry and juveniles have difficulty over-wintering in confined channels because of elevated water velocities and a lack of off-channel refugia. The Lower Elk River lacks large wood jams that formerly provided shelter from winter high flows and complex summer rearing habitat. Streamside roads in the basin may also confine the channel, creating higher velocities.

- **Invasive Non-Native Species**

Gorse, Himalayan blackberry, and scotch broom pose serious problems for agricultural land in the lower river. These species have colonized riparian zones and are inhibiting regeneration of native hardwoods and conifers that provide shade and channel stability and allow for long-term large wood recruitment. Japanese knotweed (*Polygonum cuspidatum*) has spread into areas near Port Orford and may be present in the Elk River (Oregon Department of Agriculture 2010). Japanese knotweed is aggressive, fast growing, and out-competes native vegetation in riparian areas. Scotch broom and gorse are also locally common and similarly invasive. If these plants replace conifers or hardwoods in riparian zones, coho salmon habitat will be substantially impacted.

Action ID	Target Area	Priority	Strategy	Action Description
SONCC-ElkR.12.1.41	Agricultural		Improve agricultural practices	Improve regulatory mechanisms

Step ID	***Step Description***
SONCC-ElkR.12.1.41.1	*Determine the best way to revise the Agricultural Water Quality Management Act (AWQMAP) so that it does not limit recovery of SONCC coho salmon and recommend appropriate revisions*

SONCC-ElkR.12.1.41.2 Ensure basin rules are specific and linked to implementing AWQMAP recommendations, including developing specific standards for riparian buffers SONCC-ElkR.12.1.41.3 Ensure that AWQMA plans address both impaired areas and proactive prevention of water quality impairment SONCC-ElkR.12.1.41.4 Adopt interim buffers equal to the buffer standards NMFS is recommending in Washington state until the state establishes its own buffers SONCC-ElkR.12.1.41.5 ess to a focused compliance program

SONCC-ElkR.2.7.3 Floodplain and channel structure
Improve wood recruitment, bank stability, shading, and food subsidies
Improve grazing practices

SONCC-ElkR.2.7.3.1	Assess grazing impact on sediment delivery and riparian condition, identifying opportunities for improvement
SONCC-ElkR.2.7.3.2	Develop grazing management plans to improve water quality and coho salmon habitat

SONCC-ElkR.2.7.3.3	Plant vegetation to stabilize stream bank
SONCC-ElkR.2.7.3.4	Fence livestock out of riparian zones
SONCC-ElkR.2.7.3.5	Remove instream livestock watering sources

Develop an educational program that promotes Salmon Safe methods for agricultural operations and Integrated Pest Management for rural residents

SONCC-ElkR.10.2.35 Water Quality Yes Reduce pollutants Reduce pesticides
Population wide 3d

SONCC-ElkR.10.2.35.1	*Develop a pesticide management plan*
SONCC-ElkR.10.2.35.2	*Implement pesticide management plan and technical assistance program*

Excerpts from the NMFS Status Review of OC coho salmon (Stout et al 2012)

- The BRT noted that the legacy of past forest management practices combined with lowland agriculture and urban development have resulted in a situation in which the areas of highest potential habitat capacity are now severely degraded. The combined ODFW/NMFS analysis of freshwater habitat trends for the Oregon coast found little evidence for an overall improving trend in freshwater habitat conditions since the mid-1990s and evidence of negative trends in some areas, a result which concerned the BRT. The BRT was also concerned that recent changes in the protection status of beaver (*Castor canadensis*), an animal which creates coho salmon habitat, could result in further negative trends in habitat quality.

While these historical abundance estimates are very rough and based on an assumed gill net harvest rate derived from expert opinion, they suggest that there has been a substantial decrease in ESU-wide abundance during the twentieth century. In fact, the decline was a concern to state biologists as early as the late 1940s (Cleaver 1951). Cleaver did not discuss causes of the decline other than to note that it was not caused by changes in harvest rates. However, Lichatowich (1989) related the overall decline to habitat loss, reporting a decline in production potential from about 1.4 million recruits ca 1900 to only 770,000 in the 1980s, likely resulting from habitat alterations related to timber harvest and agriculture, which both expanded on the coast between 1910 and 1950.

Table 11. Factors for decline and habitat limiting factors for OCCS (NMFS 1997c).

Modification or curtailment of	Harvest	Disease and	Regulatory mechanism	Other natural or man-made
Fish passage (hydro, tide gates, culverts)	Marine	Disease	NW Forest Plan	Droughts
Water withdrawal	Recreational	Predation	Forest practices	Floods

Land use and Logging Agricultural activities Estuary loss Wetland loss Riparian area/ quality loss Channel complexity loss Floodplain connectivity loss Splash dams/ log drives Gravel/placer mining	Dredge and fill Ag practices (sedimentation, temperature) Logging practices (sedimentation, temperature) Urban growth	Ocean conditions Artificial propagation

Table 12. Threats to OCCS ESU identified by NMFS NWR (NMFS 1997c).

Human threats	**Natural**
Agriculture: Instream wood, water temperature, substrate sediment	Drought
Forestry and private lands: Instream wood, water temperature, substrate sediment	Floods
Gravel mining: Particular concern on the southern Oregon Coast where the Umpqua and Coquille River basins have significant sediment	Wildfire
Water withdrawals or diversions: Current concern on the southern Oregon coast; future concern on mid-coast as urban areas grow Drought interaction	Tsunami
Urbanization: Floodplain functions, instream wood, substrate sediment, storm water	

- A number of studies have found negative correlations between road density and coho salmon productivity. Bradford and Irvine (2000) found that the rate at which individual coho populations declined between 1988 and 1998 in the Thompson River, British Columbia, was related to the extent of agricultural and urban land use and the density of roads in the watershed. An increase in road density was correlated to an increase in coho salmon population decline.

- Future land management actions in forest, agriculture, and urban settings with their resultant additions to the roads network have the potential to contribute to future reductions in OCCS populations and could constitute a future threat.

- **Land management—forest and agriculture conversion**

  The pressures of urban and rural residential land use affect aquatic ecosystems and salmonids through alterations of and interactions among hydrology, physical habitat structure, water quality, and fish passage. These alterations occur at local and especially watershed scales, and thus require study and management at multiple scales. Urban and rural residential development causes profound changes to the pathways, volume, timing, and chemical composition of stormwater runoff. These changes alter stream physical, chemical, and biological structure and potential, as well as the connectivity of streams with their watersheds (IMST 2010).

  The BRT discussed several modeling studies undertaken to understand the potential for conversion of lower density land uses to higher density ones. These were modeling studies by Kline et al. (2003) (see Table 19) and Lettman et al. (2009) that looked at the potential for land use conversion based on land use regulations existing at the time of the study. Kline et al. (2003), as part of the Coastal Landscape Analysis and Modeling Study (CLAMS) Project, modeled the potential expansion of urban and suburban areas in most of the OCCS ESU (Figure 23). Land use is projected to change in the ESU; primary changes are expected to be from agriculture, forest, and rural residential to urban (Table 20).

  - The results of coho salmon habitat surveys (ODFW 2009b), however, imply that loss of wetlands throughout the ESU has had a significant effect on rearing capacities of coastal basins, not just in estuaries. These losses may originate from, to name a few, stream incision and loss of connection with the floodplain, filling and diking of wetlands for agriculture and urban development, and loss of beaver-engineered wetlands due to trapping and disease. This, in addition to estuarine losses, may also have diminished the nomad life history in OCCS populations due to loss of slow water rearing areas.

  - Temperature has been negatively correlated with coho salmon survival and abundance in freshwater (Lawson et al. 2004, Crozier et al. 2008b). Temperature effects operate through a wide variety of mechanisms; beaver pond wetlands tend to moderate water temperatures, parasites are more virulent at higher temperatures (Lawson et al. 2004), and life cycle timing can be disrupted at higher temperatures, potentially leading to a mismatch between smolt outmigration timing and onset of upwelling in spring (Crozier et al. 2008b). Higher temperatures in the summer limit the quantity of stream habitat that is available for juvenile salmon rearing, while high temperatures in the fall can block adult migrants from reaching spawning grounds (Ebersole et al. 2006). The broad conclusion is that the rising temperatures anticipated with global climate change will have an overall negative effect on the status of the ESU. If 40% of the OCCS ESU is already temperature impaired (ODEQ 2007), just the effects of climate change in the absence of threats from other human activities like forestry and agriculture pose a significant risk to those systems already impaired, and increase the likelihood of temperature impairment in the rest of the aquatic systems in the ESU. The BRT considered that the effects of current water quality impairment were probably reflected in the current biological status of the species. Because of the expected effects of global climate change on OCCS habitat, water quality was considered a significant future threat to the OCCS ESU.

- The IMST (2010) report has just been released and our revision reflects its findings in the Land management—forest and agriculture conversion subsection.]

<u>Excerpts from Oregon's Oregon Coast Coho Conservation Plan:</u>

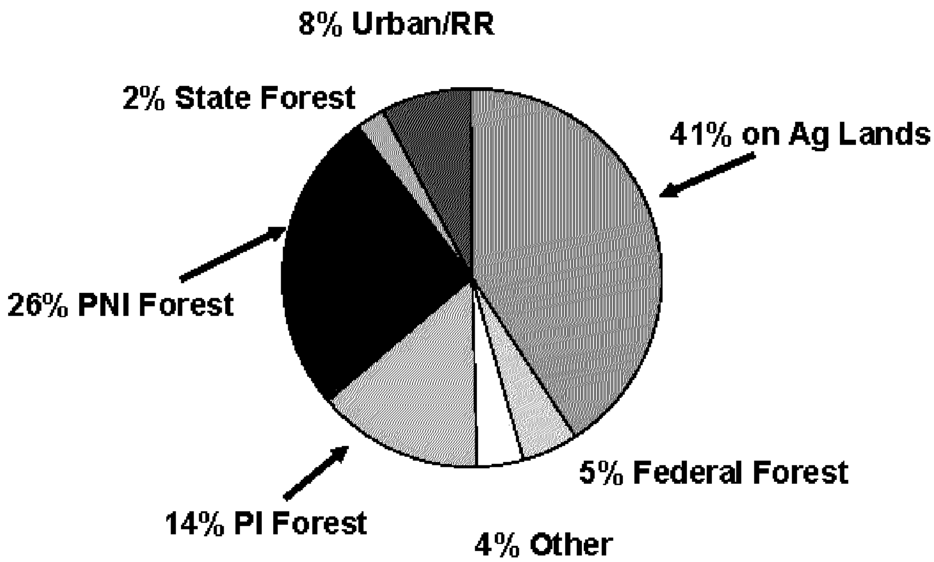
<u>Coho distribution and conservation opportunities.</u> A very high proportion (~90%) of stream reaches with the highest potential to produce coho is on private lands, including forest, agricultural, and urban lands. Land use practices and management objectives vary considerably across the distribution of coho from high gradient headwaters to estuaries.

<u>Draft pie chart showing land use and high intrinsic potential for coho productivity – ODFW staff:</u>

THE OREGON PLAN
for salmon & watersheds

DRAFT

Occurrence of High Intrinsic Potential by Land Use



Intrinsic potential analysis from Coastal Landscape Assessment and Modeling Study (CLAMS)